

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# The Limbic System

## CNS

Dr. Abdulsalam Bani Hamad  
Faculty of medicine  
Mutah university

# Introduction

- Raise your hand if you can remember **where** you were and **how you felt** when **Jordan scored its first goal against Morocco** in the recent match??



- Now, keep your hand up if you can tell me in detail what you had for **breakfast** on the Thursday of that same week.

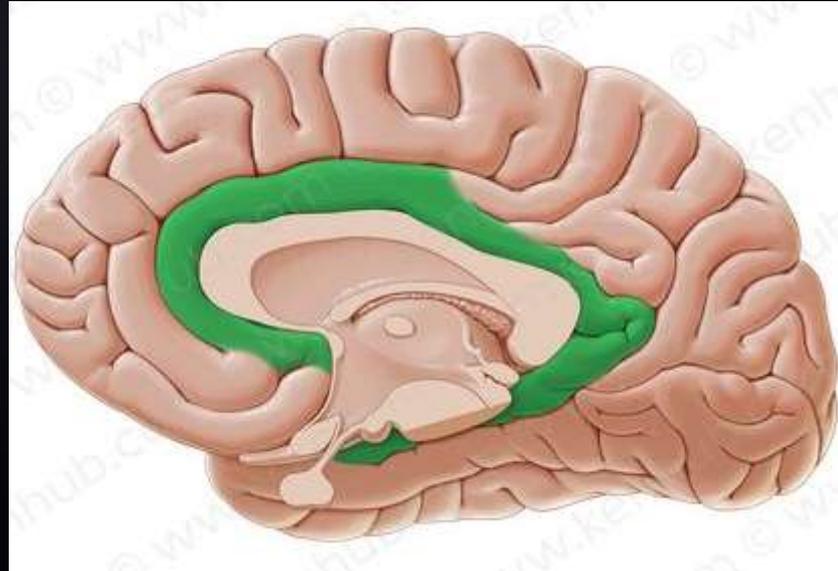
# Introduction

- The answer lies deep within our brains, in a powerful set of structures known as the **Limbic System**.



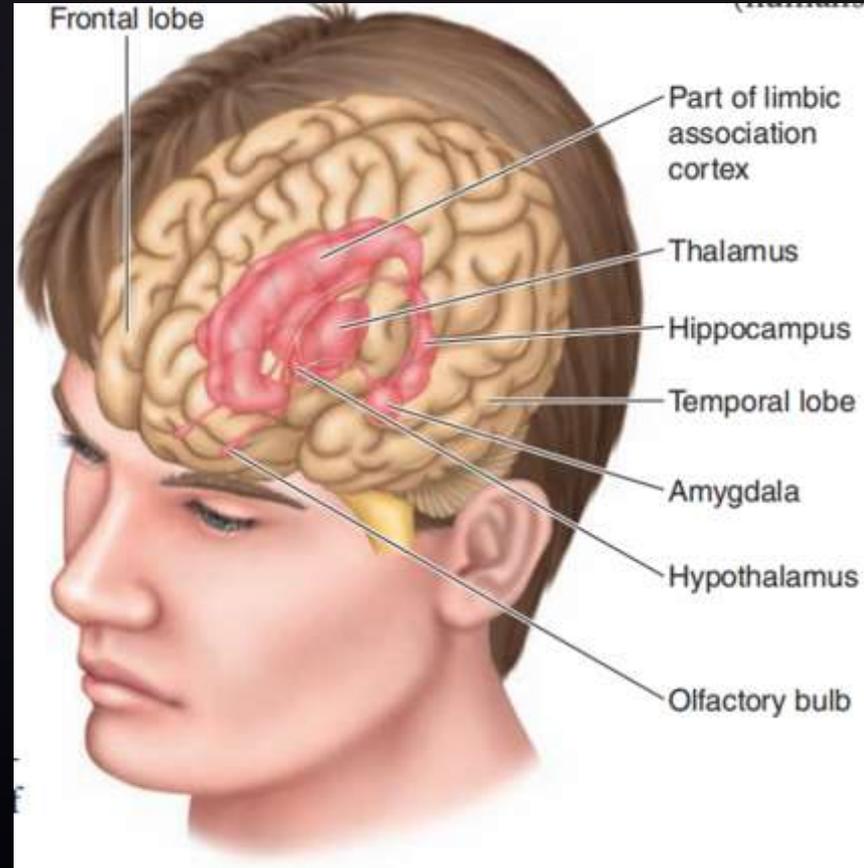
# History & Background

- The word limbic refers to **a border**.
- Broca in 1878 used the term "limbic lobe" to designate that brain tissue which surrounds the brain stem and which lies beneath the neocortical mantle.
- The limbic lobe has been considered as the **rhinencephalon**, the "**smell brain**" presumably responsible for analysis of the olfactory environment.



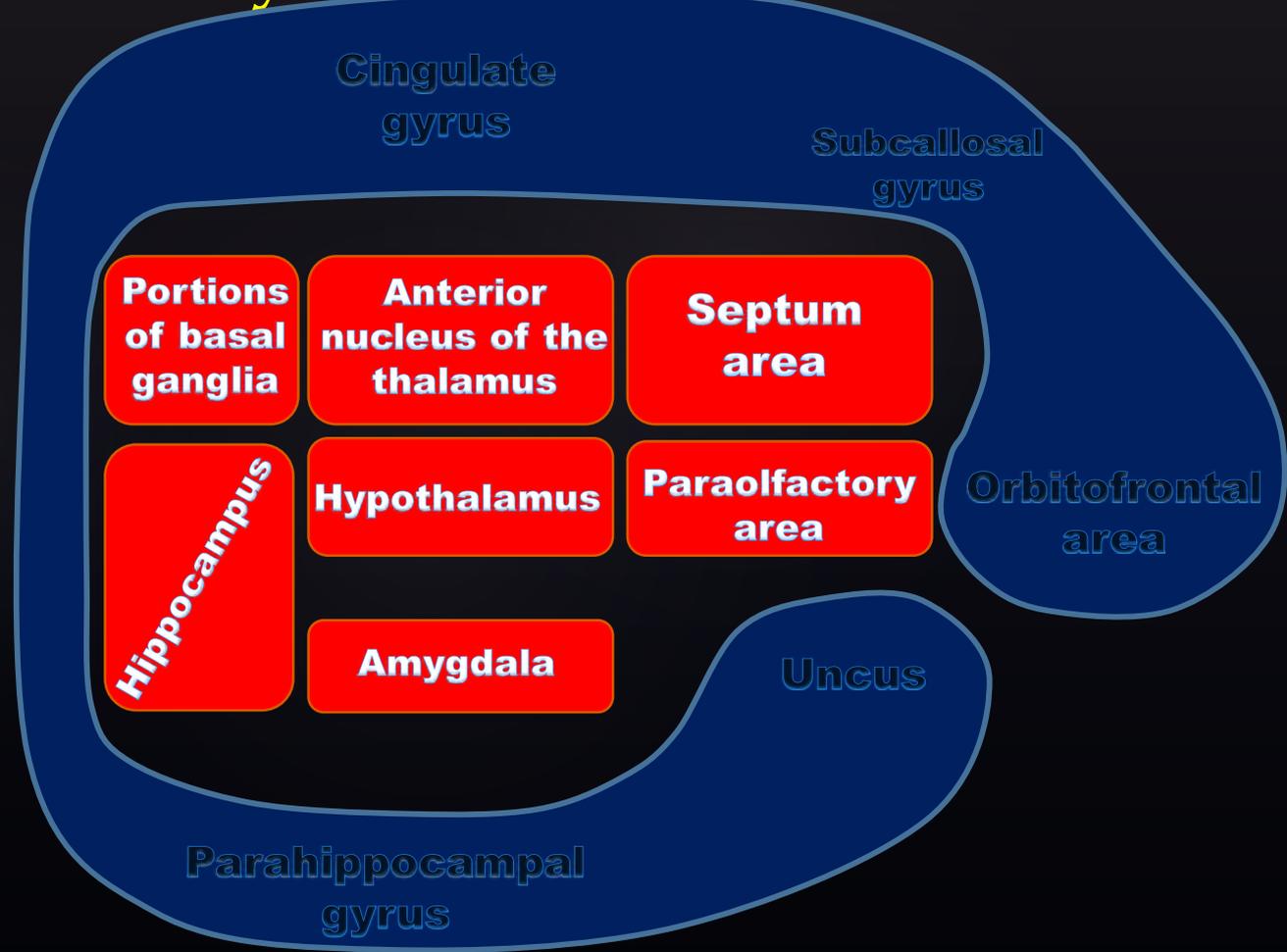
# History & Background

- The limbic system **is not a separate structure** but **a functional system** consisting of a ring of forebrain structures that surround the brain stem and are interconnected by intricate neuron pathways.
- This complex interacting network is associated with **emotions, basic behavioral patterns, motivation, learning, and memory.**



# History & Background

- Located in the middle of all these is the extremely **small hypothalamus**, which from a physiologic point of view is **one of the central elements of the limbic system**.



# Functions

## 1- Hypothalamus:

- serves as a major **autonomic nervous system** coordinating center.
- controls **body temperature**.
- participates in the **sleep–wake cycle**.
- controls **thirst and urine output**.
- controls **food intake**.
- controls **anterior pituitary hormone** secretion.
- **produces posterior pituitary** hormones.
- plays a role **in emotional and behavioral patterns**.

# 1-REGULATION OF AUTONOMIC FUNCTIONS

**Sensory Stimulus**  
(threat, pleasant sight)



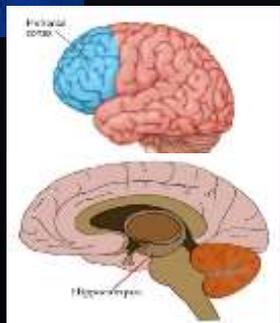
**Thalamus**  
(Relay Station)



**Slow, high Road:**  
**Sensory & Association Cortices**  
(Detailed Processing & Identification)



**Fast, low Road:**  
**Amygdala**  
(Emotional Alarm Bell)



**Prefrontal Cortex (PFC)**  
(Executive Brake/Evaluator)

**Hippocampus** (Contextual Memory)



**Amygdala**



**Hypothalamic Nuclei**

**Anterior & Medial Nuclei**

**Posterior & Lateral Nuclei**



**Brainstem Parasympathetic  
Centers**

(Dorsal Motor Nucleus Vagus,  
Nucleus Ambiguus)

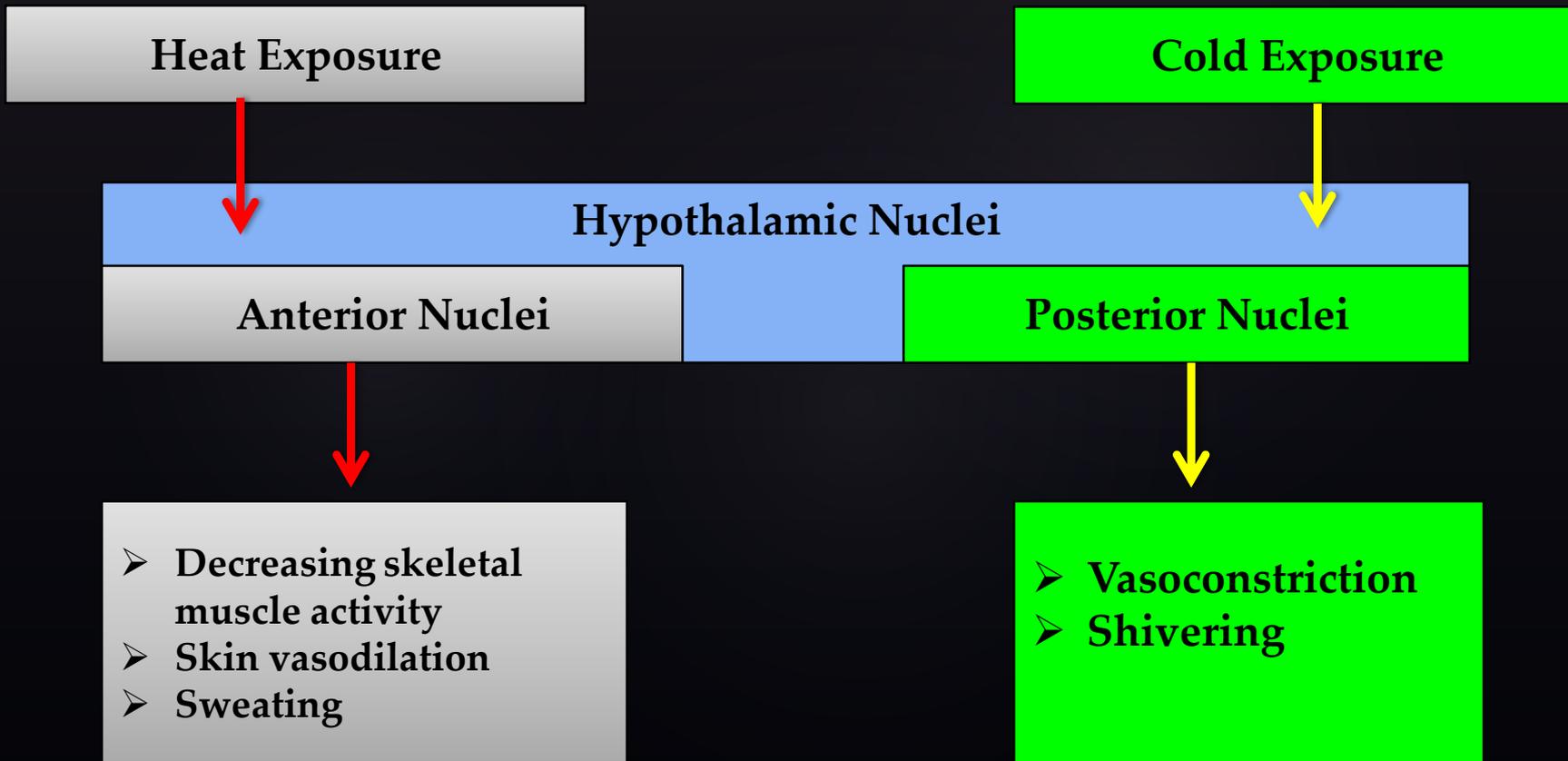
**Rostral Ventrolateral Medulla  
(RVLM)**



**Parasympathetic  
response**

**Sympathetic  
response**

# Body Temperature Regulation



# Regulation of Sleep-Wake Cycle

Anterior hypothalamus



➤ Sleep

Posterior hypothalamus

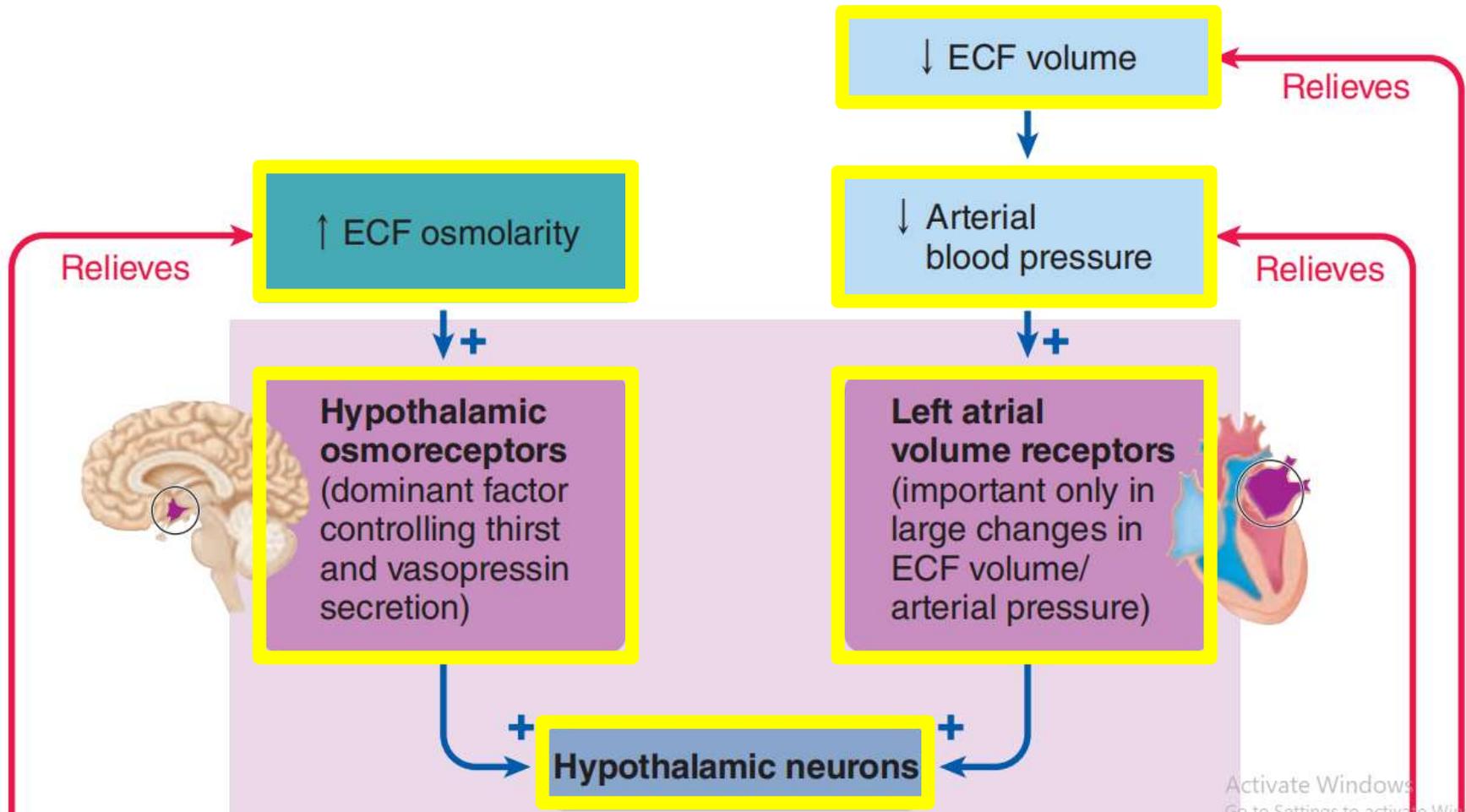


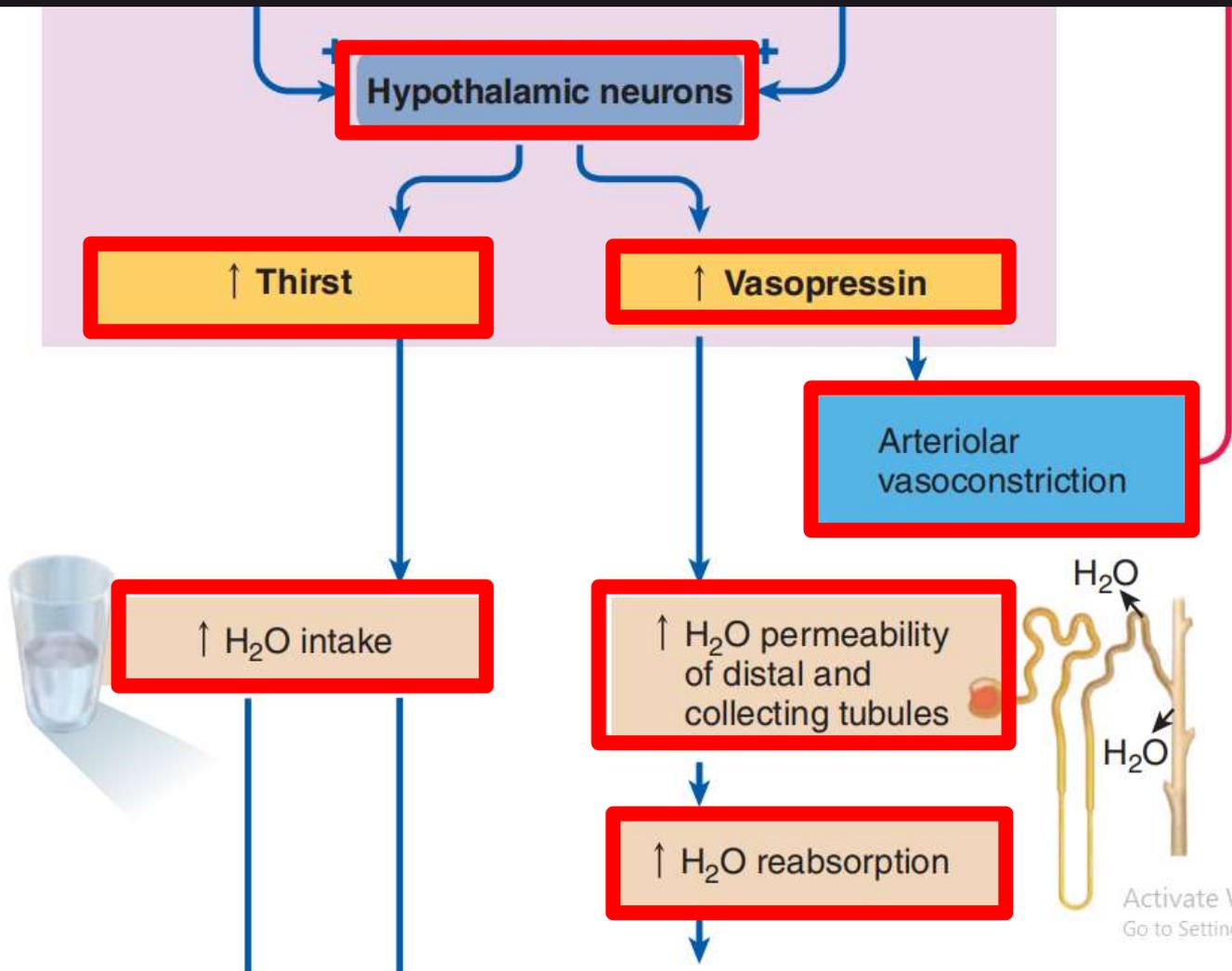
➤ Arousal

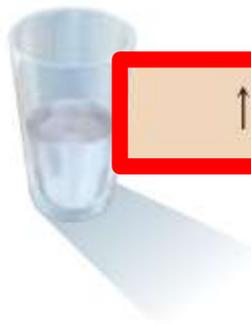
## Thirst and Urine output Regulation

- Water balance is a critical homeostatic process regulated by the central nervous system and endocrine system to maintain **blood volume, blood pressure, and plasma osmolarity.**

# Thirst and Urine output Regulation

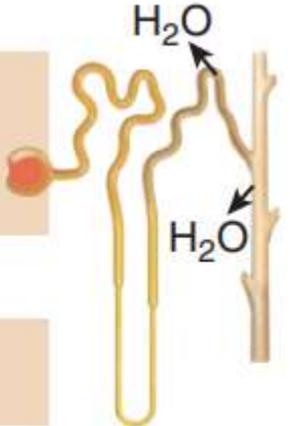






↑ H<sub>2</sub>O intake

↑ H<sub>2</sub>O permeability of distal and collecting tubules



↑ H<sub>2</sub>O reabsorption

↓ Urine output

↓ ECF osmolarity

↑ ECF volume

Activate Windows  
Go to Settings to activate Windows.

# Thirst and Urine output Regulation

- RAAS
- Angiotensin II → acts **directly** on the brain to give rise to the urge to drink and concurrently stimulates vasopressin (ADH) to enhance renal H<sub>2</sub>O reabsorption.
- Several factors affect **vasopressin secretion but not thirst**.
- **Vasopressin** is stimulated by stress related inputs such as **pain and trauma** that have nothing directly to do with maintaining H<sub>2</sub>O balance.
- In contrast, **alcohol and caffeine inhibit vasopressin secretion** and can lead to **ECF hypertonicity** by promoting excessive free H<sub>2</sub>O excretion.

## Thirst and Urine output Regulation

- One stimulus that promotes **thirst but not vasopressin secretion** is a direct effect of **dryness of the mouth**.
- **Nerve endings** in the mouth are directly stimulated by dryness, which causes an intense sensation of thirst that can often be relieved merely by **moistening the mouth even though no H<sub>2</sub>O is actually ingested**.
- A dry mouth can exist when **salivation is suppressed** by factors unrelated to the body's H<sub>2</sub>O content, such as **nervousness, excessive smoking, or certain drugs**.
- **Nonphysiological Influences**.

# Functions

1- Hypothalamus:

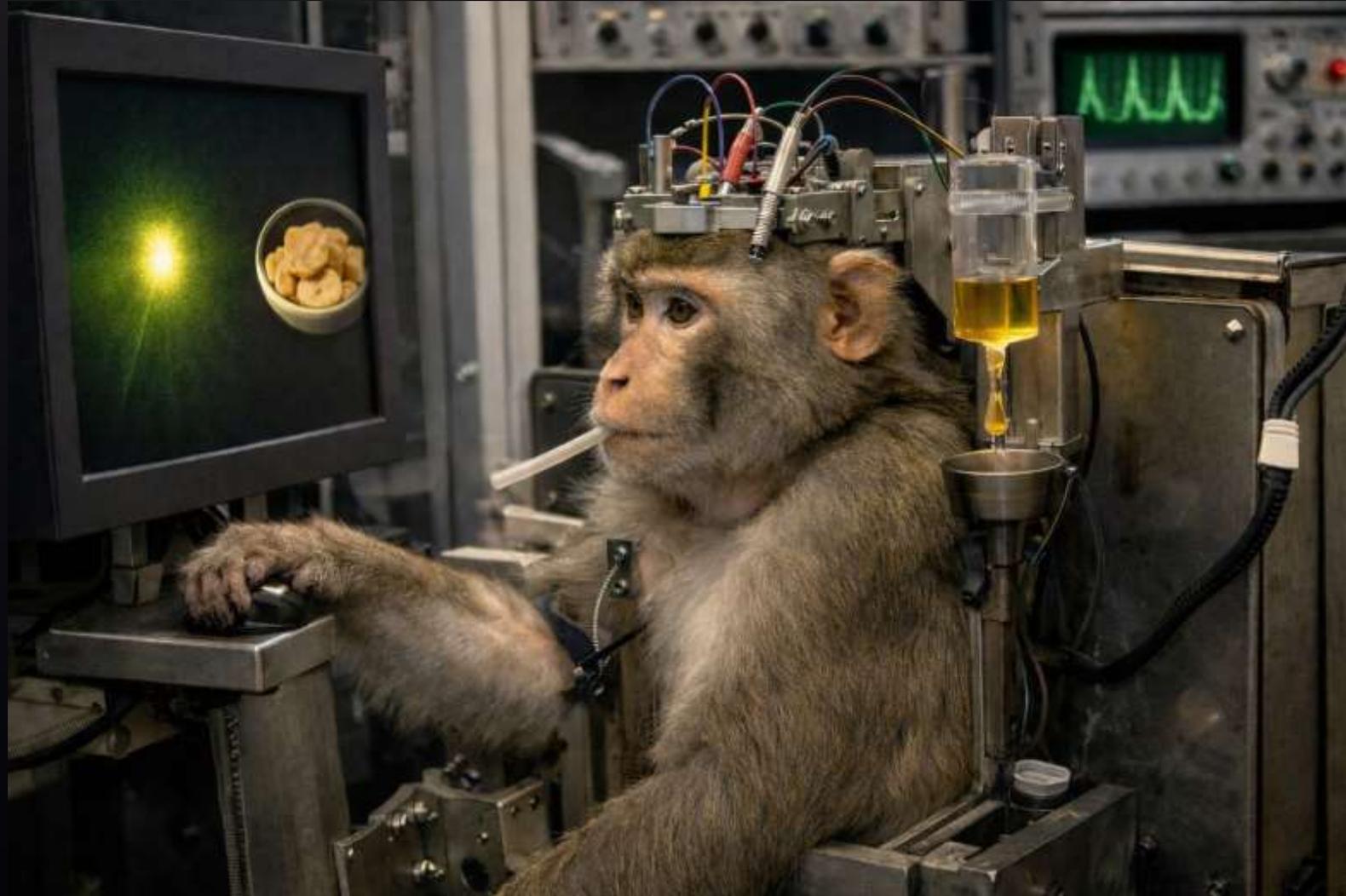
2- Amygdala: Control of Emotions.

3- Olfaction.

4- Sexual Behavior.

5- Motivation ( reward center, Punishment center ), Learning.

6- Hippocampus: Short term to long term memory ( \*\* anterograde amnesia).



## Control of Emotions:

- **Fear** is produced by stimulation of amygdaloid nucleus (**fear center**).
- Fear disappears after **bilateral amygdalectomy** e.g. Monkey approach snakes without fear.
- **Rage**: It is produced by stimulation of **lateral hypothalamus (rage area)**.
- This area is tonically **inhibited by the ventromedial nucleus (placidity area), septum & the neocortex.**

## Control of Emotions:

- **Sham rage reaction:** (extreme aggression with minor stimuli) produced by stimulation of **amygdaloid nuclei** or **lesion of ventromedial nucleus** of hypothalamus, septum or neocortex.
- **Placidity:** (calmness with little or no response to provocation) Produced by stimulation of ventromedial nucleus of hypothalamus or bilateral damage of amygdala.
- Normally there is **balance** between the rage and placidity.